

Welcome to MST125

In this module you'll study a wide range of topics from different areas of mathematics, and learn how many of them can be applied to practical problems. Familiarity with these topics will provide you with a firm foundation for further studies in mathematics and other mathematically rich subjects such as physics and engineering.

This module builds on the mathematical ideas developed in *Essential mathematics 1* (MST124), and is designed to be studied either after MST124 or at the same time as it. If you are studying the two modules with the same start date, or overlapping, then make sure that you read the important information in the box at the end of this Welcome section, and the further details in the appropriate section of the MST125 *Guide*.

Here are some of the topics that you'll meet in MST125.

Number theory, a branch of mathematics concerned with properties of the integers. You'll learn about a powerful calculating system called *modular arithmetic*, and see how this system can be used to detect errors in ISBNs (international standard book numbers) and create ciphers for disguising sensitive messages.

Conics, a family of curves that includes circles, ellipses, parabolas and hyperbolas. You'll see how these curves can be described geometrically and algebraically. You'll also learn how to represent conics and other curves by using *parametric equations*.

Geometric transformations, which include reflections, rotations and translations, and various other ways of manipulating geometric figures. You'll work with these using an algebraic approach, involving matrices and vectors.

Proof, where you'll look at how mathematical statements can be clearly expressed, and learn about various methods that you can use to prove that a statement is true, or show that it is false.

Combinatorics, where you'll meet the ideas of permutations and combinations and learn how to solve problems involving counting, such as how many different ways there are to choose a certain number of objects from a set.

Differential equations, which are equations that involve an unknown function and one or more of its derivatives. Such equations often arise in situations where the rate of change of a quantity depends on how much of the quantity there is, such as in radioactive decay or population modelling.

Mechanics, where you'll analyse the forces that act on objects, and study the motion that may be produced as a result.

You'll also have the opportunity to improve your skills in problem solving, calculus and mathematical communication, and learn how to produce properly formatted typed mathematics. You'll continue to develop your skills in using the computer algebra system introduced in MST124.

This module includes a range of topics from both pure and applied mathematics. Broadly, pure mathematics is the mathematics of abstract concepts, or mathematics that's studied for its own sake, whereas applied mathematics deals with methods and models that can be used to solve real-world problems, typically in science, engineering and economics. Number theory, for example, is normally considered to be a topic in pure mathematics, whereas mechanics is a topic in applied mathematics. However, there isn't a rigid dividing line between the two areas. Many topics, such as calculus, are relevant to both. Also, topics from pure mathematics sometimes have applications in applied mathematics, and areas of study in pure mathematics are often inspired by problems from applied mathematics. Over recent years several topics in pure mathematics, particularly in number theory and combinatorics, have been found to have important applications in areas such as computer science. This type of mathematics is different from traditional applied mathematics and is sometimes referred to as 'applicable mathematics'.

If you have finished studying MST124, or if you have never studied MST124 and are not starting it now, then you should start your study of MST125 by working through Unit 1. Otherwise, read the important information in the box below before proceeding.

Studying MST124 and MST125 together

If you are studying MST124 and MST125 with the same start date, then you should omit Unit 1 of MST125. It provides revision of material taught in MST124, so is not suitable or necessary for you at this stage. Also, you should not study the MST124 and MST125 units on the dates shown on the main MST124 and MST125 study planners. Instead, you should follow the MST124 and MST125 joint study planner, which is available from the 'Study resources' area of the MST124 and MST125 websites. This is important because you will not be prepared to study many of the topics in MST125 if you have not already studied the related topics in MST124. The joint study planner ensures that you study the units of the two modules interleaved in the correct order. As you meet new ideas in MST124, you may find it helpful to use the activities in MST125 Unit 1 as further practice.

If you started studying MST124 a few months ago and are now starting MST125, with the two modules overlapping, then you may find it helpful to study Sections 1 to 4 of MST125 Unit 1 now, as revision, and allow some time later to study Sections 5 and 6 before you study MST125 Unit 7, *Topics in calculus*. You should study the MST124 and MST125 units at the times shown on the main, individual study planners.